JPL D-12872, Rev. 1

JPL Process For Tailoring Mission Assurance To Specific Projects

January 1999

Jet Propulsion Laboratory
California Institute of Technology

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FOREWORD

This document identifies a process for tailoring Mission Assurance (MA) activities to JPL flight projects. These MA activities are to be accomplished during appropriate phases of projects involved in design, development, test, fabrication, launch and mission operations. MA is the responsibility of all participants on a project; it enhances their contribution to the success of the mission.

Project specific mission characteristics are integrated into the tailoring process such that the needs of individual projects are efficiently and cost effectively achieved. **The thrust of the process contained in this document is focused on technical standards related to the MA disciplines that require early identification of specific mission characteristics and resource constraints. The MA "Requirements" exist on a project only after their acceptance by the Project Manager.**

It is intended that **the tailoring process will result in a set of value-added MA requirements commensurate with project characteristics** and not based on a predetermined set of requirements related to a project classification.

Comments (changes, additions, deletions) that should be considered for improving this document, should be sent to:

John W. Schlue, Manager
Mission Assurance Office
Mail Stop 301-415

Revision 1

Revision "1" to this document includes the following changes that are denoted by change bars on the applicable pages:

a. Updated Mission Assurance Document Tree, Figures 1 and 2.
b. Deleted from Table 2 the "Minimum Set of Tasks" in the third column.
c. Added an implementation matrix of Mission Assurance Plan, as Appendix C.
d. Some editorial changes as summarized in the Document Change Log, see page iii.

DOCUMENT CHANGE LOG

STATUS	DATE	AFFECTED PORTIONS
ORIGINAL ISSUE	JANUARY 1997	ALL PAGES
Revision 1	January 1999	Cover Page, ii, iii, iv, 1, 2, 3, 4, 5, 6, 7, 9 and C-1

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1.0 PURPOSE

The purpose of this document is to identify a process for tailoring and integrating Mission Assurance (MA) activities into JPL flight projects that is consistent with a project's characteristics and resources. This tailoring process replaces flight hardware classification and any predetermined set of MA requirements as provided by JPL D-1489, "Flight Equipment Classifications and Product Assurance Requirements," and JPL D-8966 "JPL Standard for Flight Instrument Classification and Product Assurance Requirements." The tailoring process is described in Section 6.0 of this document and should be implemented early in the project pre-formulation or formulation lifecycle phase. Where required this process can also support Mission Assurance planning for proposal preparation activities and it can support the pre-formulation phase of Mission Assurance planning.

2.0 SCOPE

This document assists flight projects in selecting and determining the appropriate level of the MA disciplines commensurate with the specific mission characteristics of their projects. Detailed provisions for tailoring MA discipline activities are contained in the applicable Standards. These Standards are listed in Figure 1 of this document. Figure 2 contains Technical Division standards applicable to this process.

JPL contractors/subcontractors and suppliers are to be encouraged to use their processes that have been validated for a specific project application with concurrence from JPL cognizant personnel including those from the Office of Engineering and Mission Assurance (OEMA). The processes must meet the intent of applicable, good practice standards.

3.0 APPLICABILITY

This standard establishes preferred practices for JPL programs and projects in tailoring Mission Assurance requirements for their specific objectives and level of risk tolerance. It is applicable to both in-house and system contractor mode programs and projects. In the latter case, the contractor will team with JPL in the tailoring process.

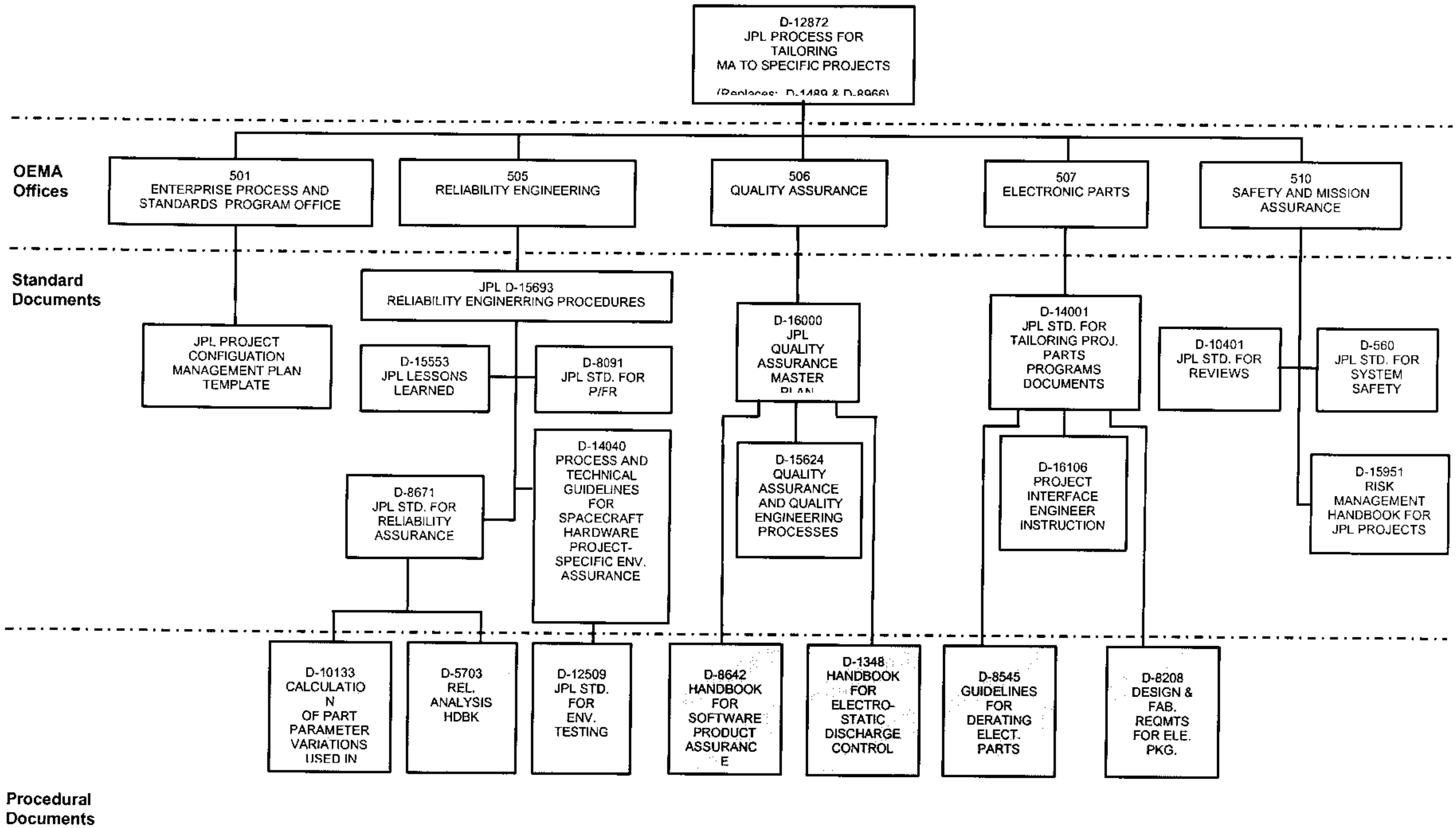
Each tailored Mission Assurance Program shall be documented in a Mission Assurance Plan for that project. These plans shall comply with NPG 7120.5A applicable requirements for NASA projects.

3.1 Faster, Better, and Cheaper Projects

The development of future JPL projects will benefit from innovative Mission Assurance processes that maximize cost efficiency in their support to the project. These processes should engage the project development teams to jointly develop value-added MA provisions that are responsive to the needs of each project, while continuously improving quality of the product.

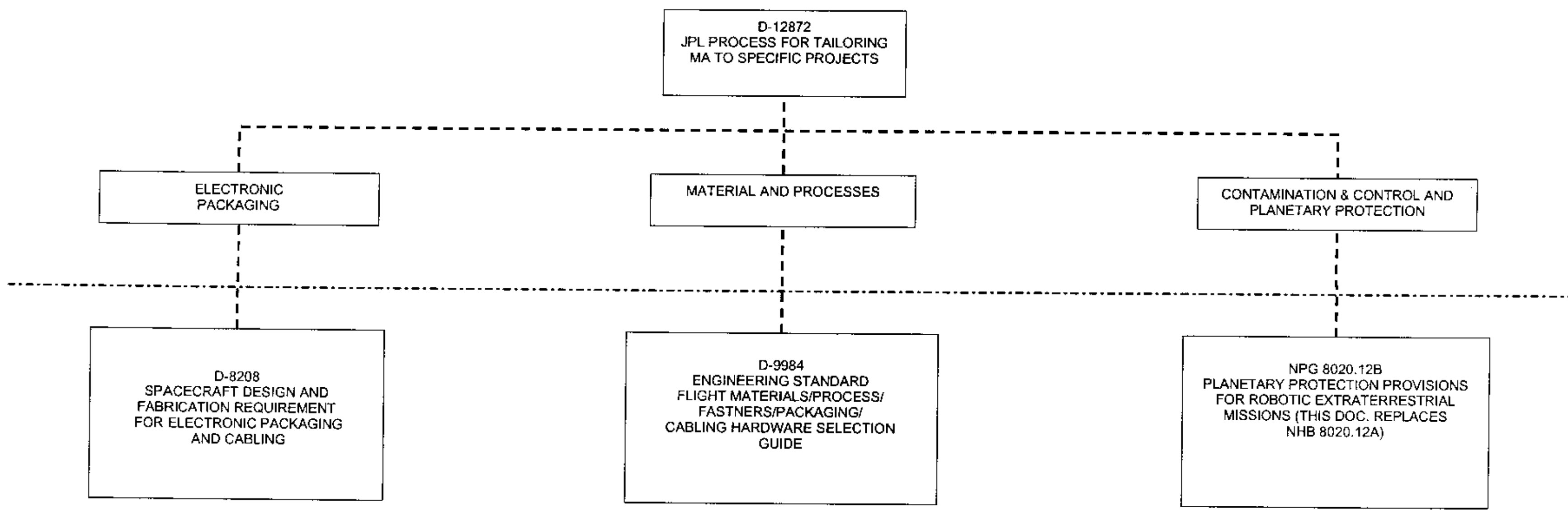
The success of Faster, Better, and Cheaper projects will require timely implementation of well-tailored MA programs in contributing to the control of development costs and meeting tight project schedules. The tailoring process should consider mission objectives and mission characteristics, such as duration and potential refly. MA support may be expanded or reduced in the tailoring process to be consistent with the project risk tolerance

Figure 1
MISSION ASSURANCE (MA) DOCUMENT TREE
OFFICE OF ENGINEERING AND MISSION ASSURANCE (OEMA)



Notes: 1) This document tree will be updated as necessary
2) All documents are released through vellum file and/or DMIE system
3) Any of the above documents that are referenced in a specific project document must have the applicable revision letter and release data on that reference.

Figure 2
MISSION ASSURANCE (MA) DOCUMENT TREE
MISSION ASSURANCE INTERFACES WITH ENGINEERING AND SCIENCE DIRECTORATE (ESD)



3.2 System Contractor/Industrial Teaming Mode Projects

The tailoring process for these projects will include the subprocess of determining the MA related strengths and weakness of the contractor so that assignment of responsibilities between the JPL and the contractor can be accomplished by complimenting one organization with the strengths of another organization. Contractor standards for MA related disciplines will be used after validation by the JPL Office of Engineering and Mission Assurance (OEMA) and the JPL project office. The validation will determine that the standards will provide good MA practices, not that they represent JPL requirements.

4.0 NASA SPONSORED PRODUCTS APPLICATION

Several of the NASA sponsored Technical Management Plans (TMPs) at JPL are developing effective MA tools, processes, and risk assessment information systems involving new technology that can be factored into the MA tailoring process for projects.

The OEMA representatives for each MA discipline will be responsible for providing this linkage with the applicable TMP products for that discipline. For instance, Test Effectiveness products will be used in the tailoring of Environmental Test requirements for candidate projects.

5.0 APPLICABLE DOCUMENTS

The following documents, of the latest issue in effect when this process is applied to a specific project, form a part of this document to the extent specified herein:

NASA

NPG 7120.5A	NASA Program and Project Management Processes and Requirements
NMI 7120.4	Launch Approval Planning for Nuclear Power Source

JPL

JPL Policy	Project Leadership Process
Other JPL Documents	See Table 2 in this document for applicable documents

6.0 THE MISSION ASSURANCE TAILORING PROCESS

The process of tailoring Mission Assurance activities begins with identifying project specific mission characteristics and their related MA disciplines as described in **Table 1**. The tailoring of MA disciplines is then accomplished as described in the documents identified in **Figures 1 and 2**. It is intended these standards will follow similar processes, as described in this document, for tailoring MA activities to their lowest task level.

The MA tailoring process overview is summarized in the subsequent paragraphs and the flow chart, **Figure 3** that relates Mission Assurance tailoring to project lifecycle phases including the preproject proposal phase.

Table 2 provides elements of Mission Assurance disciplines (including the tasks that are extremely important for each project to <u>consider</u> regardless of its cost and schedule constraints) and their corresponding standards documents. Some of the disciplines will be determined to be non-applicable to a specific project when it completes the tailoring process. The approved Mission Assurance Plan for that project will constitute verification that all disciplines have been adequately considered whether or not all disciplines are addressed in the Plan. **Appendix C provides a matrix that can be used as a check-list to verify that all Mission Assurance elements of Table 2 that are denoted by an "X" have been <u>considered</u> by the project for their applicability or non-applicability.**

6.1 Tailoring Process Overview

The tailoring process is accomplished in the following steps:

1) Determine the specific mission characteristics that satisfy the mission parameters. See **Appendix A** for definition of mission (project) parameters.
2) Determine the MA disciplines that are influenced by the project characteristics. See **Appendix B** for definition of MA disciplines.
3) Tailor the MA disciplines based project characteristics in a teaming mode with the project personnel.
4) Document and obtain final approval of the tailored MA program plan

The applicability of each of the MA discipline activities will be evaluated to determine their impact on mission risk within technical and cost restraints. **This process described in the diagram below** will result in project requirements upon approval by the Project Manager for implementation and is accomplished concurrently by the Project Development Team and MA Discipline specialists. The specific project applicable MA elements resulting from this tailoring process will be planned and implemented so that they are a value added, to the flight equipment development, test, and mission operations. Their application will be synchronized with the project life cycle for optimum cost effectiveness and will be integrated into the development team process.

TABLE 1
Matrix for Selection of
Mission Assurance Disciplines for Supporting Specific Mission Characteristics

For Project: ______________________________

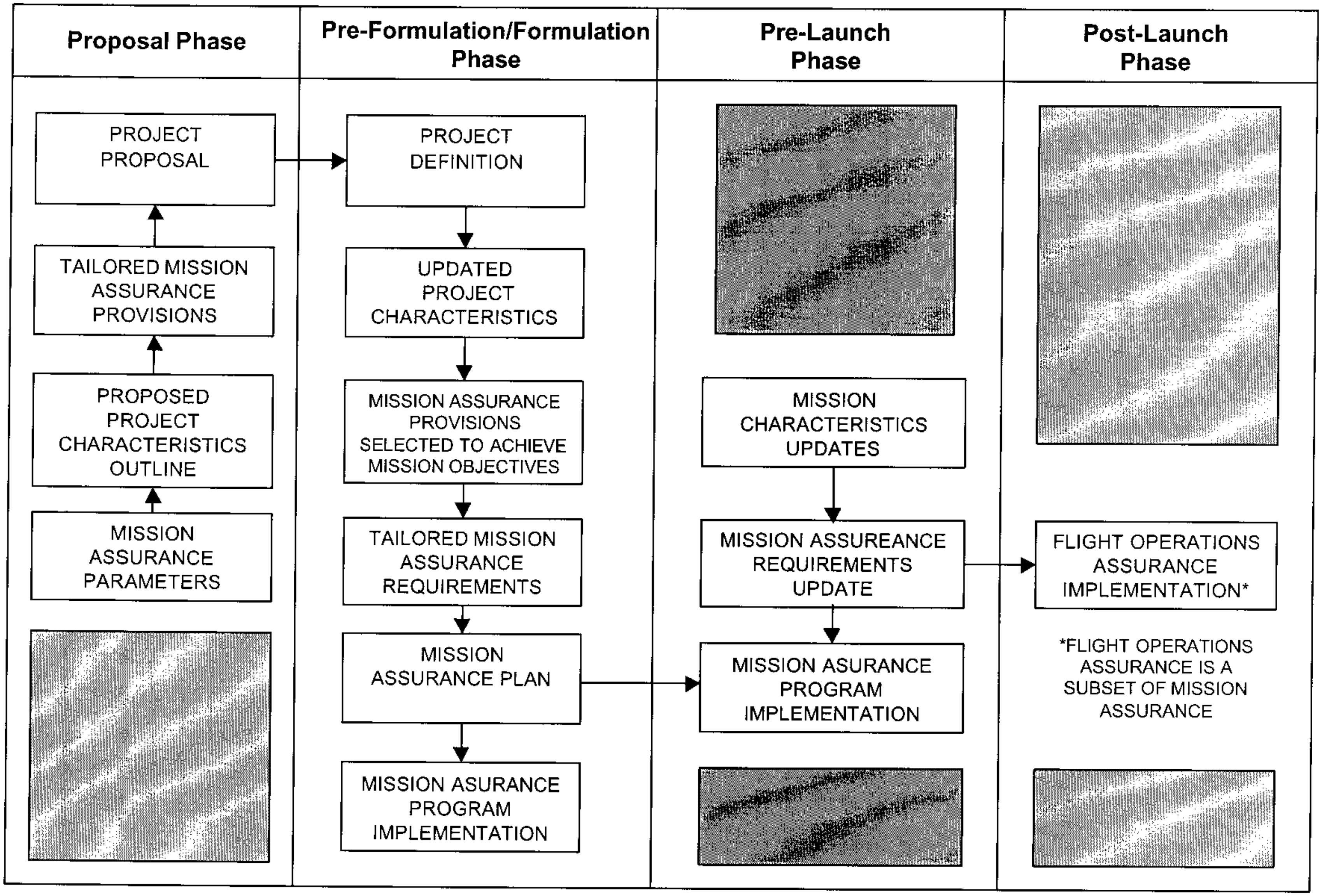
MA Discipline Selection Process:

1. **Establish Project-specific Mission Characteristics Based on Mission Parameters (Column 1)**
2. **Select Appropriate MA Discipines to Achieve Established Mission Assurance Characteristics (Column 2)**

Mission Parameters (see Appendix A for Definitions)	Mission Characteristics	MA Disciplines (see Appendix B for definitions)												
		Reliability Engineering	Problem/Failure Report	Environmental Requirements Engineering	Electronic Parts Engineering	Materials & Processes	Contamination Control	Quality Assurance	Software Assurance	System Safety	Configuration Management	Planetary Protection	Launch Approval Planning Group	Mission Operations Assurance
(Management Constraints)														
Mission Importance/Failure Consequences														
Cost of Project														
Project Schedule														
Potential for Reflight														
Project Implementation Mode														
(Mission Constraints)														
Length of Mission														
Sponsor Requirements														
Mission Flight Path (Environments)														
Launch Vehicle														
(Environments/Interface Safety Constraints)														
Launch Date Implied Environments														
(Architectural Constraints)														
Contamination Sensitivity														
Special Ground Handling Environments														
System Interface Requirements														
Mass Constraints														
Power Constraints														
Safety Issues														
Hardware/Software Inheritance														
Technology Maturity														
Flight Equipment Configuration														
Propulsion Subsystem(s)														
Pyro Devices														
Mechanisms														
Unique Flight Requirements														
Technical Performance Requirements														
Others:														
Others:														
Others:														

FIGURE 3

MISSION ASSURANCE TAILORING BY PROJECT LIFECYCLE PHASES



6.2 Mission Characteristics

The initial step of the tailoring process is to determine mission characteristics as defined in Section 6.1 and **Appendices A and B**. **Table 1** worksheet contains a generic set of mission parameters that are used as a checklist to identify mission characteristics, which are related to the MA disciplines. Blank rows are provided for the inclusion of additional mission characteristics that are specific to a project. Appropriate entries are made in the field of the **Table 1** to reflect the specific project or mission characteristics.

6.3 Project MA Requirements

The tailored project MA discipline activities will be the basis for **"Project Requirements"** which will require approval by the Project Manager. These requirements are the product of the tailoring process described in the preceding paragraphs and will be documented in the Project MA Plan and in supporting documents such as Specification, implementation plan, and Design requirements. Project Office has the final approval authority for implementation of tailored MA requirements as documented in the Project MA Plan. The MA Office supports the Project Office by ensuring that its MA Plan provides the appropriate balance in risk acceptance and risk mitigation based on project objectives and resource constraints.

6.4 Project MA Plan

The Project MA Manager or another MA designee has the responsibility for the budgeting, planning, coordination and documentation of the project activities that are incorporated into the Project MA Plan. The plan reflects the tailored requirements developed by the Project Office and the MA Specialists. These "requirements" are derived from the matrix worksheets. Once the Project Manager approves the MA Plan, the provisions become MA Requirements. Deviations from the approved plan can be authorized by the Project Manager by approving a waiver.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Reliability Engineering	• Reliability Assurance Plan (Project Specific)	X		JPL D-8671 Std. for Rel. Assurance
	• Single Failure Point (SFP) Policy	X		
	• Reliability Analyses:			
	- Failure Mode Effects and Criticality Analysis (FMECA)			
	- FMECA of interface circuits (piece part level)	X		
	- Worst Case Analysis (WCA)			
	- Power Supply Transient Analyses			
	- Electronic Parts Stress Analysis (PSA)	X		
	- Structural Stress Analysis			
	- Thermal Stress Analysis			
	- Redundancy Switching Analysis			
	- Fault Tree Analysis (FTA)			
	- Single Event Effects Analysis (SEEA)			
	- Reliability Trade-off Studies			
	- Parameter Trend Analysis			
	- Additional Analysis			
	• Review Plan	X		JPL D-10401 Std. for Reviews
	• Minimum Operating Time for Electronics:			None (Project to identify)
	- For Spacecraft Assembly			
	System			
	- For Instruments			
	• Problem/Failure Reporting (PFR)			JPL D-8091 Std for P/FR
	- PFR Plan	X		
	- Initiation of H/W PFR Reports			
	- Reliability Eng. Review & Approval			
	- Red-Flag P/FRs			

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Environmental Engineering	• Environmental Design Test and Analysis Plan – Units/configuration to be tested or analyzed • Environmental Design Requirements • Environmental Test Specification • Test Procedures • Environmental Test Requirements • Others (Refer to Std. Document)	X X X		JPL D-14040 Std. for Environmental Compatibility Assurance

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Electronic Parts Engineering	• Kinds of parts/devices and their Reliability Pedigree	X		JPL D-14001 Std. for Electronic Parts
	• Parts Program Document	X		
	• Standard Parts			
	• Preliminary Parts List			
	• Nonstandard Part Approval Request			
	• Parts Screening			
	• Parts Derating			
	• GIDEP Alerts			
	• Failure Analysis			

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Materials and Processes	• Materials and Process Program Plan • Materials Engineering Certification • Others	X		JPL D-9588 Std. for Non-electronic Parts, Material & Processes

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Contamination Control	• Contamination Control Plan • Others	X		D-9497 Generic Contamination Control Plan for EOS

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Quality Assurance	• Quality Assurance Plan • Contractor Quality Assurance Surveillance • Workmanship Inspection • Post-Environmental Test Inspection • MRB • End-Item Data Package Verification • Shipping Inspection	X		JPL D-1771 Std. for Quality Assurance

Notes:

1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Software Product Assurance	• Software Product Assurance Plan • Others	X		JPL D-9586 Std. for Software Product Assurance

Notes:

1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
System Safety	• System Safety Plan • Others	X		JPL D-560 Std. for Flight System Safety and JPL D-11411 Std. for Flight Safety for Contractors

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Configuration Management Hardware and Software	• Configuration Management Plan	X		JPL Project Configuration Management Plan Template

Notes:

1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
Planetary Protection	• Planetary Protection Plan • Others	X		NASA Policy NMI 8070.7 and the implementing provision of NHB 8020.12

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

Table 2
Mission Assurance Disciplines and Applicable Standards

MA Disciplines	Elements of MA Disciplines	Strongly Recommended	Project Selection	Applicable Standard Document
LAPG	• National Environmental Policy Act (NEPA) Requirements	X		NEPA
	• NEPA Implementing Procedure	X		NMI 7120.4 and NHB 8800.11

Notes:
1. Project Manager/Mission Assurance Manager or their delegatee selects appropriate elements of the MA disciplines in Column (2) and checks them off in Column (4).
2. "X" denotes that these tasks are extremely important to the mission success of a project regardless of its cost and schedule constraints.

APPENDIX A

MISSION (PROJECT) PARAMETERS DEFINITIONS

APPENDIX A

MISSION (PROJECT) PARAMETERS DEFINITIONS

NOTE: Specific project characteristics are derived from these generic parameters

1. **Mission Importance/Failure Consequences** - Brief statement about the importance of the mission objectives to the NASA sponsor, the USA, JPL, and the effect that the visibility and consequences of failure would have for them and/or the science community.

2. **Estimated Cost of Project** - Estimated project cost through post launch into Mission Operations (i.e., proposal to post-launch phases).

3. **Project Schedule** - A predicted timeline of the project Phase proposal to post-launch phases.

4. **Potential Refurbishment/Re-fly** - A statement regarding the possibility that the flight equipment could be refurbished, and re-certified for a reflight.

5. **Project Implementation Mode** - Identification of planned project mode system contractor teaming, in-house, or subsystem contractors, etc.

6. **Length of Mission** - Length of time that the flight equipment must perform per its functional requirements.

7. **Sponsor Requirements** - Identification of special Mission Assurance related requirements imposed on the project by the sponsor.

8. **Mission Flight Path Environments** - A description of the complete mission profile beginning with launch through end of mission and a brief highlight of unique environments based on the flight path. Month and year of launch should be identified also.

9. **Launch Vehicle** - Description of launch vehicle location of launch site and any unique safety or environmental implications associated with its use.

10. **Launch Date and Related Environments** - Month and year of spacecraft launch and definition of any related environmental factors such as solar flare predictions.

11. **Contamination Sensitivity** - A description of the contamination sensitivities, interface requirements or constraints expected to exist in the flight equipment. Similarly, the sensitivities related to planetary protection on missions to other planets.

12. **Ground Handling Environment** - A description of the unique ground handling environments that could require special consideration such as analyses, testing, protection, etc.

13. **System Interface Requirements** - System interface requirements (hardware or software) of flight equipment such as an instrument to be flown on a platform or a spacecraft, or spacecraft/launch vehicle interface requirements.

14. **Mass Constraints** - The predicted mass constraints of the flight unit or spacecraft which will influence architectural trade-offs related to reliability.

15. **Power Constraints** - The predicted power constraints of the flight unit or spacecraft which could influence electronic parts decisions in the design process.

16. **System Safety Concerns** - Special safety concerns that need to be considered for personnel, facilities, fabrication, assembly, testing, handling, transportation, integration, launch site and contractors.

17. **Hardware and Software Inheritance Plans** - Description of the hardware/software inheritance plans along with a definition of previous flight history when it is known.

18. **Flight Hardware and Software Technology Maturity** - Assessment of the anticipated hardware and software technology maturity relative to its probable qualification status at the time of the flight equipment development and test. Also, the description of flight software and its associated characteristics, such as, number of lines of code, language, etc.

19. **Flight Equipment Configuration Complexity** - An identification of expected complexities such as high density packaging, radiating sources such as RHUs, RTGs, use of composite materials, any known hazardous (flammable or toxic materials, etc.)

20. **Propulsion Subsystem** - A description of the propulsion subsystem if one is required.

21. **Pyro and Explosive Devices** - An overview of expected pyro and explosive devices on the flight unit or spacecraft.

22. **Flight Mechanisms** - A listing of expected mechanisms such as deployable booms, articulation devices, etc.

23. **Unique Flight Requirements** - An overview of unique flight requirements such as a very low temperature-operating requirement.

APPENDIX B

MISSION ASSURANCE DISCIPLINES DEFINITION

APPENDIX B

KEY MISSION ASSURANCE DISCIPLINES DEFINITION

MISSION ASSURANCE DISCIPLINES DEFINITIONS

1. Reliability Engineering (RE)

The objectives of this discipline are to define and support the implementation of the Project's reliability assurance plans such that the design risks are balanced with project objectives and constraints. This discipline performs reliability assessment and verification of the hardware design characteristics so that design deficiencies and functional performance risks are detected, accepted or mitigated early in the design process. Key activities within this discipline involve design architecture trade-offs, failure mode identification and problem avoidance, and design analysis validation, functional performance validation with respect to operational environments and mission lifetime, and technical evaluations of related programmatic risks. Implementation of an adequate reliability assurance plan will benefit the project by contributing to a robust design, with an optimal balance between design verification tasks and project cost and schedule constraints, and minimize the probability of very late and costly detection of problems which could threaten mission launch schedules or mission objectives.

2. Environmental Requirements Engineering (ERE)

The objectives of this discipline are to define the environmental design and verification requirements for the project based on the flight environment predictions. The tailoring process will include an assessment of potential failure mechanisms and the selection of environmental tests/analyses most capable of exposing design/workmanship deficiencies selected to those failure mechanisms. Key activities within this discipline consider the impacts of the project/mission environments on design definition, verification (i.e., via analysis and test) and technical evaluations of related risks. Those activities benefit the project or task by increasing the confidence in the flight equipment capability to perform as required throughout exposure to the predicted mission environments. Environmental Requirements includes Dynamics, Thermal, EMC and Natural Space Radiation and other space environments such as Micrometeoroid

3. Problem/Failure Reporting (PFR)

The objectives of this discipline are to define and support the implementation of an effective system for minimizing the probability of in-flight recurrence of problems and failures detected during the hardware and software development phase of the project. PFRs can provide a controlled, closed-loop system for problem/failure identification, reporting, analysis, and corrective action, to avoid in-flight recurrences of functional nonconformance (including both actual and suspected problems/failures). This activity benefits the project by validating the adequacy and completeness of the investigation, analysis, and corrective action steps implemented to resolve hardware problems/anomalies and will result in a high probability that in-flight mission threatening or mission catastrophic events will be avoided.

4. Electronic Parts Engineering (EPE)

The primary objective of the EPE is to assist the flight projects in selection and acquiring the best electronic parts for their applications and within the constraints of their resources, risk tolerance, and schedule. This objective is met by establishing guidelines for selection, procurement screening, and application of EEE parts, and reviewing performance relative to the project requirements. It is also met by generating, maintaining, and controlling Approved Parts Lists, as required. The benefits of the project include the best compromise of parts, functionality, characteristics, quality, and reliability that the project budgets and schedules can afford. An additional benefit is the insertion of new Parts technology into the project and the prevention of parts problems from occurring to the extent possible.

The new small spacecraft and instruments must also make tradeoffs between existing parts and the use of customized parts to save mass and power. These are questions that are done within the BPE function.

5. Materials and Processes (MP)

The objectives of this discipline are to ensure that all materials and processes used in flight equipment are compatible with the mission requirements for structural integrity, functionality, outgassing, safety, etc. The activities encompass the selection and utilization of materials and processes. It develops, qualifies, evaluates and implements materials and processes control requirements for the flight projects. Materials and Processes benefit the project by ensuring efficient and cost-effective utilization of materials and by ensuring the use of materials that are compatible with the mission requirements.

6. Contamination Control (CC)

The primary objective of the CC is to ensure that flight equipment will not become contaminated prior to launch or in flight beyond performance requirement elements. The contribution as of CC to a project includes the analysis and coordination to achieve the required cleanliness Level(s); the predicted degradation in cleanliness during flight the methods for achieving, verifying, and maintaining the cleanliness. The benefit includes enhanced science success of flight instruments, prevention of spacecraft system failures or functional degradation and compliance with NASA Planetary Protection requirements (e.g., Mars missions).

7. Quality Assurance (QA)

The primary objective of the QA function is to ensure that the project-adopted requirements are met. It is the charter of the QA to assist a project in proactively identifying problems associated with a flight hardware quality (e.g., materials, workmanship, mfg. processes, electronic packaging design, etc.). The primary activities for meeting these objectives are vendor/facility surveys, workmanship standards review and qualification, manufacturing process review and qualification, in-process inspections, end-item/pre-cap inspections, and design review (elect. pkg.). In addition, applied research relating to manufacturing technologies and electronic packaging and interconnection are undertaken to aid QA's support posture to the JPL projects.

The discipline activities include Problem/Failure and Incident Surprise Anomaly Reporting; Risk Assessment; Operations Training Assessment, Problem/Failure Trend Analysis; Uplink and Downlink Assurance; Configuration Management Assurance; Command Assurance; and Awareness Training relative to flight operations. This support benefits the project by ensuring that commanding is accomplished with established procedures/processes and that flight anomalies are properly documented, assessed and resolved.

8. Software Assurance (SA)

The primary objective of Software Assurance is to help ensure the operational integrity of software including its interfaces with non-software (i.e., hardware or computer human interfaces) parts of the system. Primary activities in this discipline include technology transfer and training; requirements assurance and verification/validation (or testing); design and causal analysis; process, product, and MA. The benefits of support to the project by SA engineers, working concurrently during all phases of the software lifecycle is to minimize risks early in the lifecycle (i.e., at the requirements and design levels) and maximize prevention of software defects that can cause mission degradation or failure.

9. System Safety (SS)

The primary objective of SS is to proactively prevent accidents, illness, injury, fatalities, damage or unforeseen events that would cause loss of a mission or incur scheduled launch delays and budget increases for Personnel, Flight Hardware/Software, Facilities and related support equipment. Systems Safety is comprised of seven key areas:

- Identification - Scope and scenario of the Mission and Hardware
- Safety plan - Applied approach to Personnel and Hardware Safety
- Hazard analysis (including those induced by software) - What are the hazards?
- Fault protection analysis - How is the fault protection (FP) design verified?
- Control - How are the hazards controlled?
- Verification - How are the hazard controls verified?
- Certification - Launch Agency Safety Reviews.

Benefits of System Safety include:

- Safeguarding of personnel, hardware and facilities.
- Preventing hazards from occurring.
- Ensuring safe prelaunch activities.

10. Configuration Management (CM)

The primary objective of CM is to provide a template of visibility, control, and traceability needed to properly manage product development activities on the project. Configuration Management is comprised of four key areas; Identification (i.e., What are we building?); Control (i.e., How are changes controlled?); Status Accounting (i.e., How is information recorded and reported?) and Audits (i.e., How are requirements verified?)

The benefits of CM include: 1) Advance warning of problems (by summing status information). 2) Availability of as-designed and as-built product information needed for risk assessment and corrective action planning. 3) Control of project costs (by controlling changes).

11. Planetary Protection (PP)

The objective of PP is compliance with the NASA policy NMI 8070.7E and the implementing provisions of NHB 8020.12B. For missions not involving Mars, compliance is reporting and includes some contamination control. The benefits of PP include support to the project in meeting requirements for Mars missions, missions to other solar system objects of PP interest and/or provision of PP requirements for any planetary missions.

12. Launch Approval Planning Group (LAPG)

Objective: assist flight projects during pre-proposal phase or no later than phase A to comply with two launch approval requirements as required by law. Simply stated these requirements are given in:

1) NEPA (National Environmental Policy Act)
2) NASA NMI 7120.4 launch approval planning for nuclear power source (RTGs and RHUs) missions, and Presidential Directive/NSC-25

NEPA compliance is required by NEPA regulations (Public Law 90-190, USC 4321-4347). NASA implementing procedures are covered by (CFR1216.3 and NASA NHB 8800.11). All flight projects must comply with these regulations and/or laws. The goal of these laws, requirements and procedures is to provide an Environmental Assessment (EA) or Environmental Impact Statement (EIS) early in the planning phase. The EA/EIS will enable Project sponsors to make the necessary decisions and give approval early in the planning phase so that funding can be acquired to enable project startup. Not to comply with the aforementioned laws and regulations can if the project is in Phase A and/or B, cause serious schedule delays if approval has not been received by NASA Center and Project Manager.

13. Mission Operations Assurance

Mission Operations Assurance function typically begins with the launch of the flight spacecraft/instrument, but may also begin as early as one year prior to launch, depending on the scope of preparation for launch and mission operations. The Mission Operations Assurance Functions identified below may be tailored to be consistent with the project risk tolerance. The development and implementation of Mission Operations Assurance task focuses on robust process and procedures, to reduce the risk of transmitting an incorrect command to the flight spacecraft/instrument. The thrust of the effort focuses on the prevention of errors in order to reduce the amount of resources required for rework and correction of command errors. These functions include:

- Uplink command assurance to reduce the risk of transmitting an incorrect command.
- Command and Sequence uplink tracking to provide audit trail, reporting and trend analysis.
- Coordination of command error tracking, investigation, correction and reporting.
- Investigation, closure and tracking of in-flight hardware, software and operational anomalies.

- Mission Operations process and procedure development and maintenance.
- Risk management and reporting responsibilities to Project and OEMA.
- Focus on adherence to processes and procedures and continuous process improvement.

APPENDIX C
MISSION ASSURANCE PLAN
("X" Denoted Mission Assurance Elements From D-12872 Implementation Matrix, Table 2)

Project/Program: ______________________ **Prepared by:** ______________

Date: ______________

"X" Denoted Elements of Mission Assurance Disciplines	Applied to Project		Rationale for Selecting "No"
	Yes	No	
Reliability Engineering			
• Reliability Assurance Plan (Project Specific)			
• Single Failure Point (SPF) Policy			
• Failure Mode Effects and Criticality Analysis (FMECA) Interface			
• Electronic Parts Stress Analysis (PSA)			
• Review Plan			
• Problem Failure Reporting (PFR) Plan			
Environmental Engineering			
• Environment Design Test & Analysis Plan			
• Environment Design Requirements.			
• Environment. Test Requirements			
Electronic Parts Engineering			
• Types of parts/devices and their Reliability Pedigree			
• Parts Program Document			
Materials and Processes			
• Materials and Process Program Plan			
Contamination Control			
• Contamination Control Plan			
Quality Assurance			
• Quality Assurance Plan			
Software Product Assurance			
• Software Product Assurance Plan			
System Safety			
• System Safety Plan			
Configuration Mgmt. Hardware and Software			
• Configuration Management. Plan			
Planetary Protection			
• Planetary Protection Plan			
LAPG			
• National Environment. Policy Act (NEPA)			
• NEPA Implementing Procedure			

Approvals: ______________________ ______________________

Mission Assurance Manager   Project Manager or Designee

Change History:

This Revision:

Effective Date: January 29, 1999
Revision Number: 1
Description: This procedure supersedes Revision 0, effective date: January 1, 1997. Revisions to this document include the following changes that are denoted by change bars on the applicable pages:

a. Updated Mission Assurance Document Tree, Figures 1 and 2.
b. Deleted from Table 2 the "Minimum Set of Tasks" in the third column.
c. Added an implementation matrix of Mission Assurance Plan, as Appendix C.
d. Some editorial changes as summarized in the Document Change Log, see page iii.

Previous Changes:

Effective Date: January 1, 1997
Revision Number: 0
Description: This is a new procedure.